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I also certify that the attached copy of the request for grant of a Patent (Form 1/77) bears an amendment, effected by this office, following a request by the applicant and agreed to by the Comptroller-General.

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Signed P. Mahoney

Dated 25 June 1999

Patents Form 1/77

Patents / 977
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27 OCT 1998
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The Patent Office

28OCT98 E400561-1 002837
P01/7700 0.00-9823529.4

# Request for grant of a patent

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The Patent Office

Cardiff Road
Newport
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1. Your reference

SAB/MS/CLARKE.3b/42448/002

2. Patent application number
*(The Patent Office will fill in this part)*

**9823529.4**

27 OCT 1998

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

DOMINIC LE PROVOST
TANYARD FARM
LOWER WEAR
NR AXBRIDGE
SOMERSET BS26 2JG

Patents ADP number *(if you know it)*

7539104001

If the applicant is a corporate body, give the country/state of its incorporation

NO

4. Title of the invention

A TAPERED STRUCTURE

5. Name of your agent *(if you have one)*

WITHERS & ROGERS
4 DYER'S BUILDINGS
HOLBORN
LONDON
EC1N 2QP

Form 51/77
Laynes Dairy
52-54 High Holborn
LONDON
WC1V 6RR

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

Patents ADP number *(if you know it)*

1776001

1032001

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

| Country | Priority application number *(if you know it)* | Date of filing *(day / month / year)* |
|---|---|---|
| GB | 9818642.2 | 26.08.1998 |
| GB | 9806713.5 | 27.03.1998 |

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

| Number of earlier application | Date of filing *(day / month / year)* |
|---|---|
| | |

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

*a) any applicant named in part 3 is not an inventor, or*
*b) there is an inventor who is not named as an applicant, or*
*c) any named applicant is a corporate body.*
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NO

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| Continuation sheets of this form | |
| Description | 11 |
| Claim(s) | -- |
| Abstract | -- |
| Drawing(s) | 15 +15 (S) |

10. If you are also filing any of the following, state how many against each item.

| | |
|---|---|
| Priority documents | -- |
| Translations of priority documents | -- |
| Statement of inventorship and right to grant of a patent *(Patents Form 7/77)* | -- |
| Request for preliminary examination and search *(Patents Form 9/77)* | -- |
| Request for substantive examination *(Patents Form 10/77)* | -- |
| Any other documents *(please specify)* | -- |

11. I/We request the grant of a patent on the basis of this application.

Signature Withers & Rogers — Date 26th OCTOBER 1998

WITHERS & ROGERS

12. Name and daytime telephone number of person to contact in the United Kingdom: SIMON BECK — 0117 925 3030

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Case ref: SAB\MS\CLARKE3b

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# A TAPERED STRUCTURE

This invention relates to a tapered structure which, amongst other things, may be used as a musical instrument. Such a structure can formed from a sheet of foldable material. The invention also relates to a blank of foldable sheet material for forming the tapered structure.

In the field of acoustics, horns are generally classified according to their geometrical shape. Figure 1 shows, for example, a pyramidal horn with an open rectangular base, and a tubular wall comprising four planar trapezoidal shaped panels. The apex of the pyramid is truncated to form a throat section through which acoustic energy may be transmitted or received.

Figure 2 shows a conical horn in which the tubular wall forms a continuous panel circumscribing an acoustic channel within. The geometrical structures shown in Figures 1 and 2 are characterised by their cross-sectional area increasing linearly with the distance from their throat. These structures, by virtue of their shape, may be formed from a single sheet of foldable material. The blank for the pyramidal horn is shown in Figure 4, with the four panels labelled 41, three fold lines labelled 42, and a tab for holding the structure together labelled 43.

Figure 3 shows a sectoral horn in which one of the sets of two opposing panels are planar and parallel, and the other set of opposing panels are flared. This particular structure is characterised by the cross-sectional area increasing non-linearly with the distance from the

throat. This non-linearity of the cross-sectional area improves the efficiency of the horn structure in channelling acoustic energy to or from the throat. However, whereas the shape of the structures of Figures 1 and 2 enable them to be formed from a sheet of foldable material, the geometrical structure of Figure 3 must be formed by fastening together the separate panels.

According to a first aspect of the present invention there is provided a tapered structure formed from a sheet of foldable material, the tapered structure comprising a wall member having a plurality of fold lines defining the edges of a plurality of juxtaposed panels, characterised in that two adjacent fold lines are curved to form a non-planar panel bound by said curved fold lines.

A structure in accordance with the present invention has an advantage that it by using curved fold lines instead of straight fold lines as used in the pyramidal horn, a panel or panels of the structure may be made non-planar. The use of curved interfaces between adjacent panels enhances the strength of the structure and its ability to withstand sheering and crushing forces.

The structure has a base end and an apex end, also referred to as the mouth and the throat respectively. It is possible that one or both of these ends is closed.

In a preferred embodiment, at least one pair of the curved fold lines converge towards the apex end, and may contribute to the general convergence of the tapered structure i.e. the decrease of the cross-sectional area towards the throat.

Preferably at least one pair of the curved fold lines converges towards the base end of the tubular wall. In this case, the curved fold lines may converge to a point at or near the base end.

Ideally, at least one non-planar panel has a concave external appearance, and has mirror symmetry in a plane substantially perpendicular to the panel.

Advantageously, the wall member may include a second non-planar panel, opposite the first non-planar panel, and also having a concave external appearance. The first and second panels may be of different size and one or both may stop short of the base. Advantageously fold lines may be disposed in the non-planar panels, thereby allowing the tapered structure to be folded flat. This is advantageous for transport and storage.

The wall member may include two further opposing non-planar panels, joining the first and second non-planar panels, and having a generally convex external appearance.

A preferred embodiment of the invention has first and second non-planar panels which are generally elliptically shaped. Alternatively, the first and second non-planar panels may be regarded as being generally petal shaped. In a further embodiment, the first and second non-planar panels may be regarded as being generally trapezoidal shaped with the non-parallel sides being curved.

In one embodiment of the invention, the base and/or apex end of the wall member may be closed. Closure of one of the ends enables the horn structure to be used as a container. The container may, if made of liquid resistant material, function as a drinking vessel. The closure for the throat may be formed as an extension of the wall. The extension may be an integral part of the wall and include additional fold lines to allow the opposed walls to be folded to seal the end of the container.

The tapered structure may also be used as an acoustic horn for a musical instrument. The acoustic horn may advantageously have a cross-sectional area which varies non-linearly (generally increasing) with the distance from the throat.

An internal channel may be formed within the horn. The channel may carry a vibrating element. It is thus possible to form a kazoo within the horn.

Preferably the channel is integrally formed with the horn. The channel may be formed by folding a portion of the sheet of foldable material.

Advantageously at least one orifice or notch may be cut into a wall of the internal channel in order to support the vibrating element. The vibrating element may, for example, be formed from a thin paper, plastics or metal sheet and which can be forced into vibration when a user modulates a flow of air into the horn with their own vocal cords. In a preferred embodiment the foldable material is laminated and the laminating material extends over the orifice or notch to form the vibrating element.

Advantageously a single line of adhesion, which may be provided by glue and/or sticky tape such that the tapered structure can be formed from the unfolded blank of material in a relatively easy folding operation. Advantageously the line of adhesion is a straight line.

According to a second aspect of the present invention, there is provided a tapered structure comprising at least first, second and third wall portions, wherein the wall portions co-operate in use, to form a channel, and wherein the second portion is intermediate the first and third portion, is bounded by two arcuate curves, and has a concave surface.

According to a third aspect of the present invention there is provided a sheet of material having three pairs of fold lines formed therein, wherein each pair of fold lines are arcuate and serve to define five portions, and in which the lines in each pair curve so as to define three tongue shaped portions, separated by intervening regions.

The present invention will further be described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a perspective view of a pyramidal horn;

Figure 2 is a perspective view of a conical horn;

Figure 3 is a perspective view of a sectoral horn;

Figure 4 is a plan view of a blank for the pyramidal horn of Figure 1;

Figures 5a, 5b, 5c, and 5d are views of a horn structure in accordance with the invention in various orientations;

Figure 6 is a perspective view of another horn structure in accordance with the invention;

Figure 7 is a plan view of a blank for the horn structure of Figure 6;

Figure 8 is a plan view of a blank for the horn structure of Figures 5a, 5b, 5c, and 5d;

Figures 9a and 9b are end and exploded views of the throat of a horn constituting a further embodiment of the invention;

Figure 10 shows part of the blank for the horn of Figures 9a and 9b;

Figure 11 illustrates a blank for a horn having a modified panel shape so as to define a linear line of adhesion; and

Figure 12 illustrates a blank of Figure 11 with a double sided adhesive tape in place.

Referring to Figures 5a, 5b, 5c, and 5d there is shown a horn structure which is formed by folding a sheet of material. The material may be any foldable material, such as paper, card, suitably thin sheet metal, or plastics.

The horn structure has a single wall which is wrapped around a channel or cavity, and joins back onto itself to form a hollow tube-like structure. The horn has an open base end 51, known as the mouth, having a relatively wide cross-sectional area. The cross-sectional area of the channel decreases along the length of the horn to an open truncated apex end 52, otherwise known as the throat of the horn. The horn has first and second opposed concave surfaces 54 and 55, respectively. Each surface 54 and 55 is provided with respective longitudinally extending fold lines, as indicated by the chain lines 58. Thus the surface 54 is divided into portions 54a and 54b. The first concave surface 54 extends from the throat 52 to the mouth 51 of the horn. The second concave surface 55 only extends part of the way towards the mouth 51. This results in the creation of a pyramidal region 59 where the second concave surface and the opposed side walls 60 and 61 come together. This pyramidal region imparts structural stability into the horn.

The horn can be moved between it's flat and 3-dimensional states at will. This does involve some stressing of the material of the horn, which "clicks" into its final state as the horn is constructed from its flat to its 3-dimensional form. This sudden change into the final 3-dimensional state also enhances the structural rigidity of the horn and inhibits it from

inadvertently returning to its flat state. Of course, the horn may be provided without the fold lines 58 if it is not to be folded flat.

Referring also to Figure 8, there is shown a blank for the horn structure of Figures 5a to 5d. The blank is delimited by an outline 71, and has four fold lines 72, 73, 74, 75 which divide the blank into three generally elliptical areas 76, 78, 80, albeit being truncated at one end, and first and second intermediate areas 77, 79. There is also a flap or tab section 81 joined by a fold line to the first intermediate area 77. After folding the blank along the fold lines, the blank is then wrapped around onto itself such that the outer elliptical areas 76 and 80 coincide or overlap, and the flap section 81 overlaps with the area 79. With the blank folded and wrapped the horn structure of Figures 6a to 6d is formed, and may remain in that form by gluing or fastening both the overlapping elliptical areas 76 and 80, and the overlapping flap 81 and area 79 to one another in a known manner. The elliptical area 78, and the coincident elliptical areas 76 and 80 form two opposing concave panels of the horn. These panels are joined by two opposing convex panels formed by the intermediate areas 77, 79. The curved nature of the fold lines, which convergence towards the base end, combined with the arc or sector like symmetrical shape of the overall blank produce a horn structure which is flared i.e. the cross-sectional area of the horn increases non-linearly with the distance from the throat. This improves the acoustic performance of the horn.

The first generally elliptical area may be provided as only a half elliptical area by removing a portion 76' therefrom, thus causing the edge of the blank to be delimited by line 71' in that portion of the blank.

Figure 6 shows an alternative embodiment of the horn structure in accordance with the invention, in which the base end is symmetric. The blank for this horn structure is shown in Figure 7, with like references referring to like features. This blank does not include the flap or tab 81 of the Figure 8 embodiment.

Although the tapered structure in accordance with the invention is particularly useful in the field of acoustics, it may also be used beneficially in a variety of other applications. For example, by closing the truncated apex end of the structure by means of an additional, integrally folded panel, the structure may be used as a hand-held container for foods, such as sweets, or in the case of the embodiment shown in Figures 5a to 5d a scoop. Furthermore, by use of suitable liquid resistant material or coatings, the container can be used to hold beverages. Other uses of the tapered structure include use in hat making where the curved lines provide an aesthetically pleasing appearance.

It is possible to form a musical instrument, such as a kazoo, integrally with the horn. As shown in Figures 9a and 9b, an internal channel 100 can extend forwardly within the throat section of the horn. Figures 9a and 9b show the horn in a state intermediate its flat and fully constructed forms in order that the separation between the various elements can be more clearly shown. The channel comprises first and second walls 102 and 104 which are hingedly attached together along a longitudinally extending line 106. The walls 102 and 104 do not include fold lines therein. In its fully constructed state, the top of the channel 100 is defined by a further wall 108 which is composed of two wall portions 108a and 108b separated by a

fold line 58. In the fully constructed state the walls 108a and 108b follow the same path, at least partially, as the panel 54 of the completed horn. The wall portions 108a and 108b extend immediately from the panel portions 54a and 54b. The walls 102 and 104 are separated from the first and second intermediate regions 77 and 79 by first and second triangular portions 112 and 114 which serve to form end walls which, in use, close the throat of the horn and ensure that air flow into the interior of the horn has to occur via the internal channel 100. One of the walls 102 and 104 of the internal channel carries a flap 116 which is, in use, is adhered to the other one of the walls 102 and 104 thereby ensuring that the channel is formed. Additionally, one of the walls of the channel has an aperture or orifice formed therein for supporting a vibrating element 118 which forms the acoustically active part of the kazoo. The horn may be laminated to protect it and the laminating material, for example a plastics film, may extend over the aperture in the wall of the channel so as to form the vibrating element.

In a further modification, panels 130 and 131 are provided to define part of the path of a glue line which runs diagonally across the blank, as shown in Figure 12. The panels 108a and 108b are also modified so as to form foldable portions 132 and 134, respectively, which lie on the path of the glue line.

In use, the end portion 140 is folded under the remainder of the horn, and the portions 132 and 134 are also folded back, thereby providing means for adhering the end portion 140 in position. The flap 138 is adhered to the corresponding portion 138a of the glue line.

Similarly flap 136 is adhered to portion 136a, flap 130 to portion 130a, and flap 131 to portion 131a.

Thus the completed structure can be easily assembled, especially so when the glue line is provided by double sided adhesive tape. The tape may be cut away in those portions where it is not overlying the blank.

Small holes 144 may also be provided through which a cord or similar may be threaded (either before or after construction of the horn) to create a carrying loop, which may be a neck cord.

It is thus possible to form a structurally complex shape, comprising a kazoo and an acoustic horn from a single sheet of material, with the exclusion of the vibrating element, and only requiring three fastenings, for example by glue, to be made. Furthermore, the instrument can fold flat for easy transport.

It will be evident in view of the foregoing that various modifications may be made within the scope of the present invention. For example, there may be more than two, e.g. 3 or 4, concave elliptical panels distributed around the tubular wall member. The closure of the throat may be made as a novelty shape to enhance the appearance of the horn.

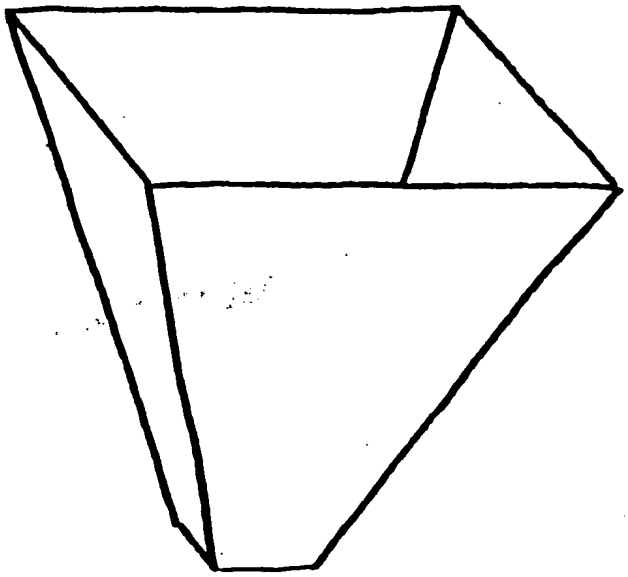


Fig. 1

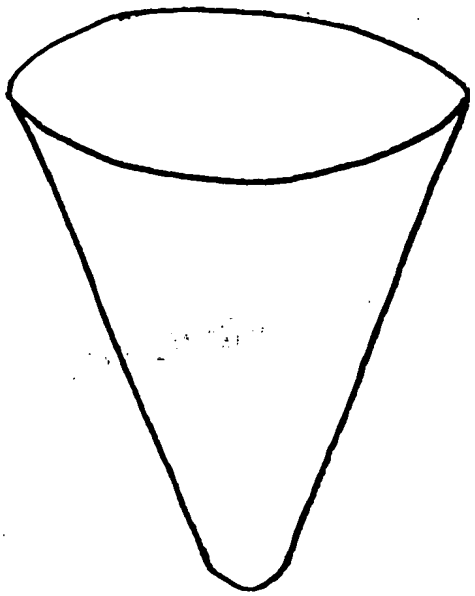


Fig. 2

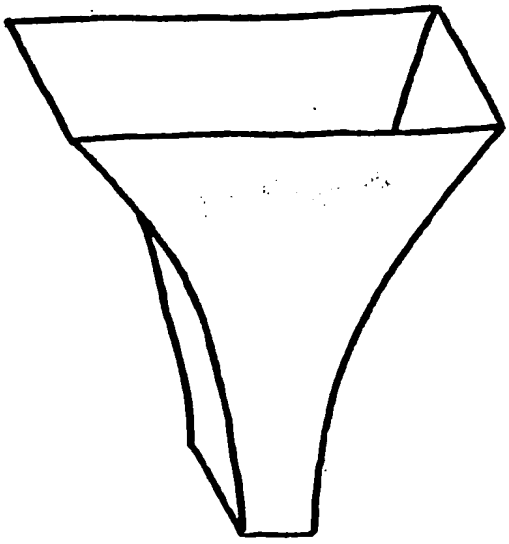


Fig. 3

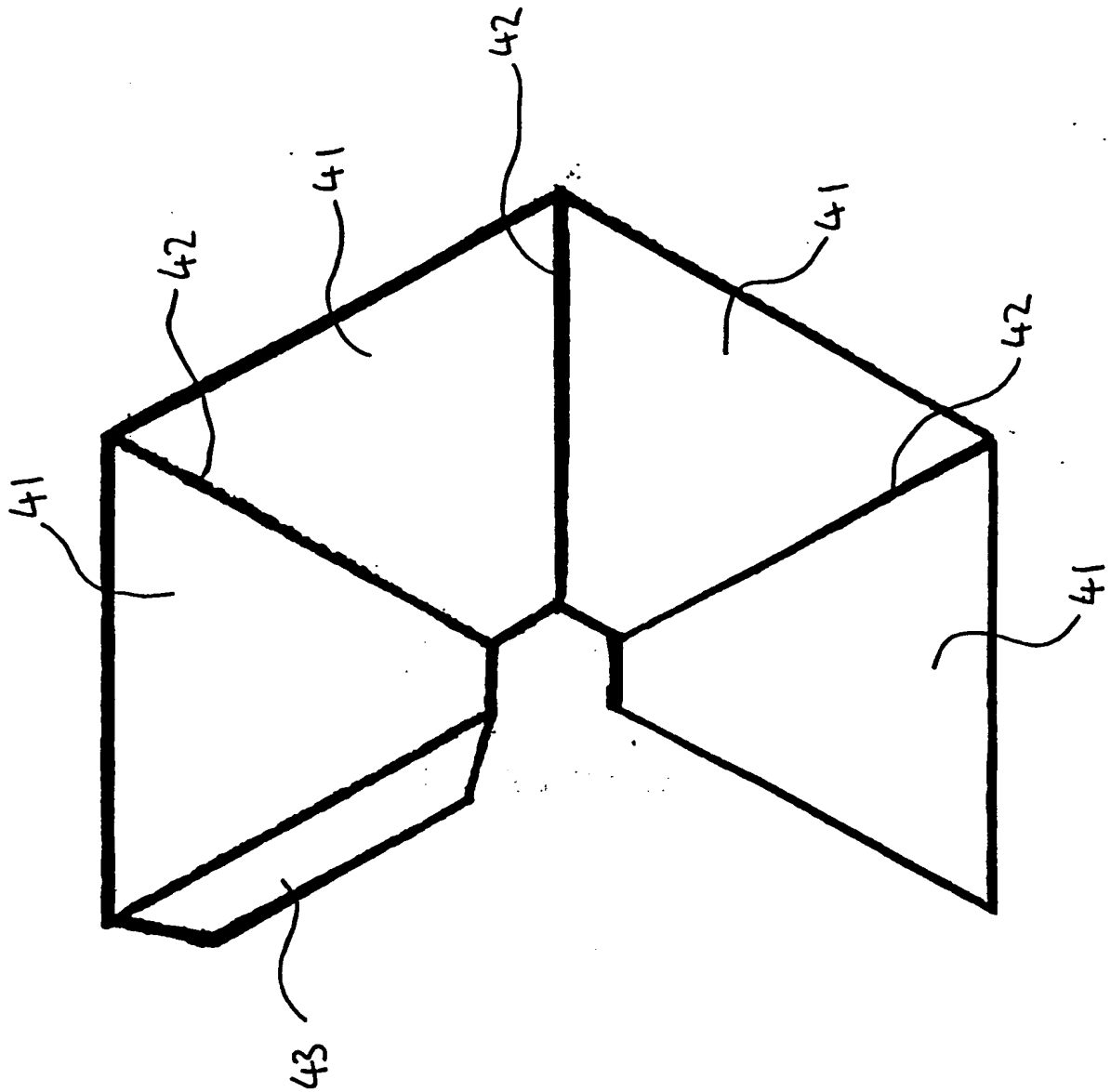



Fig. 4

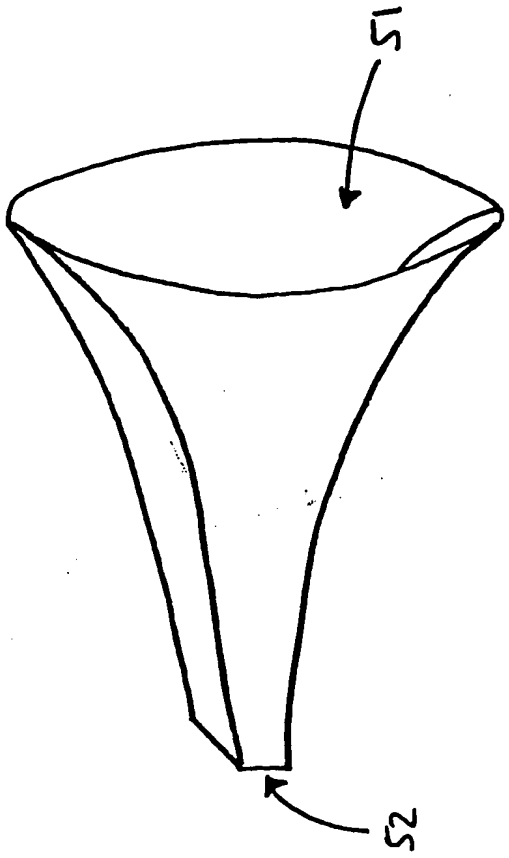



Fig.6

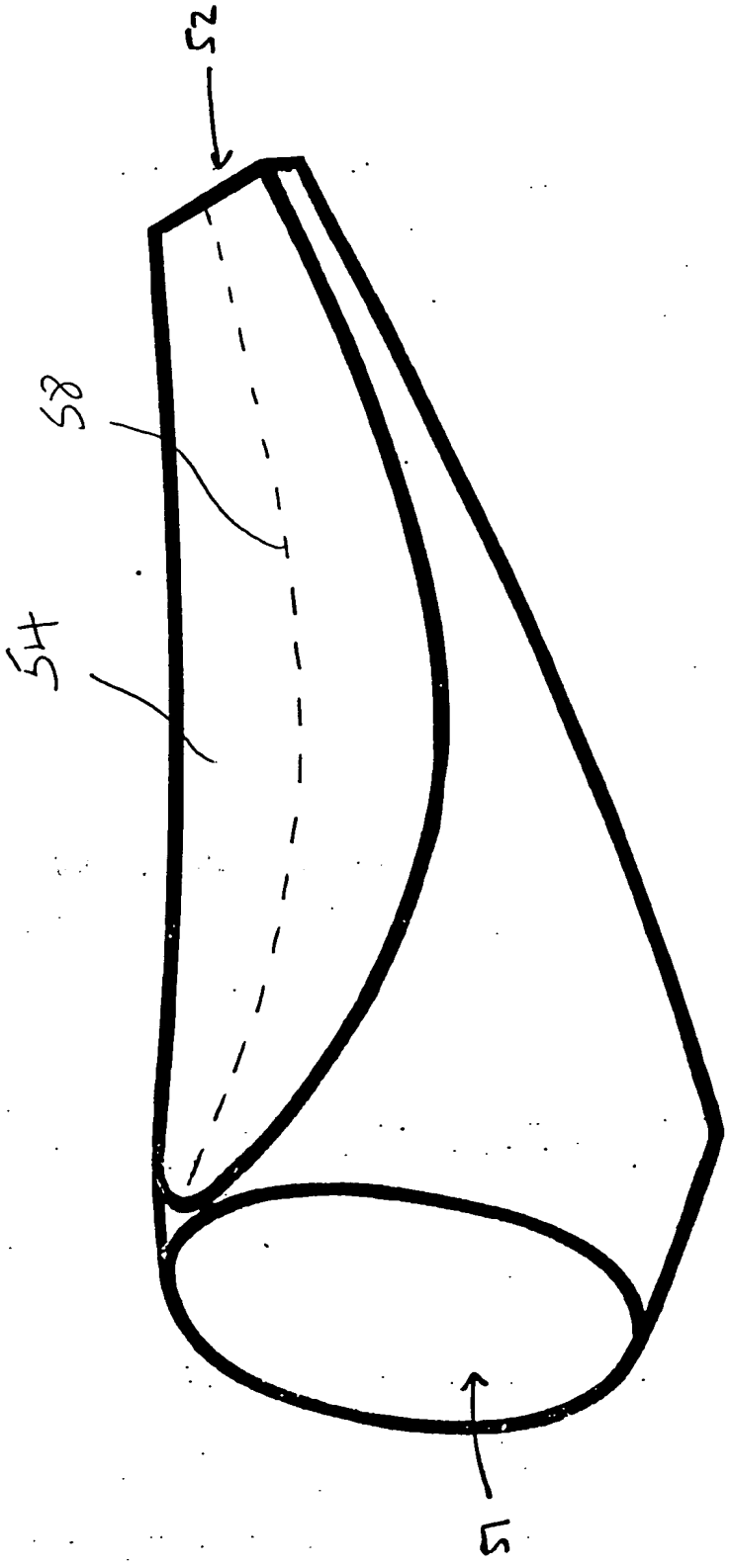



Fig. 5a

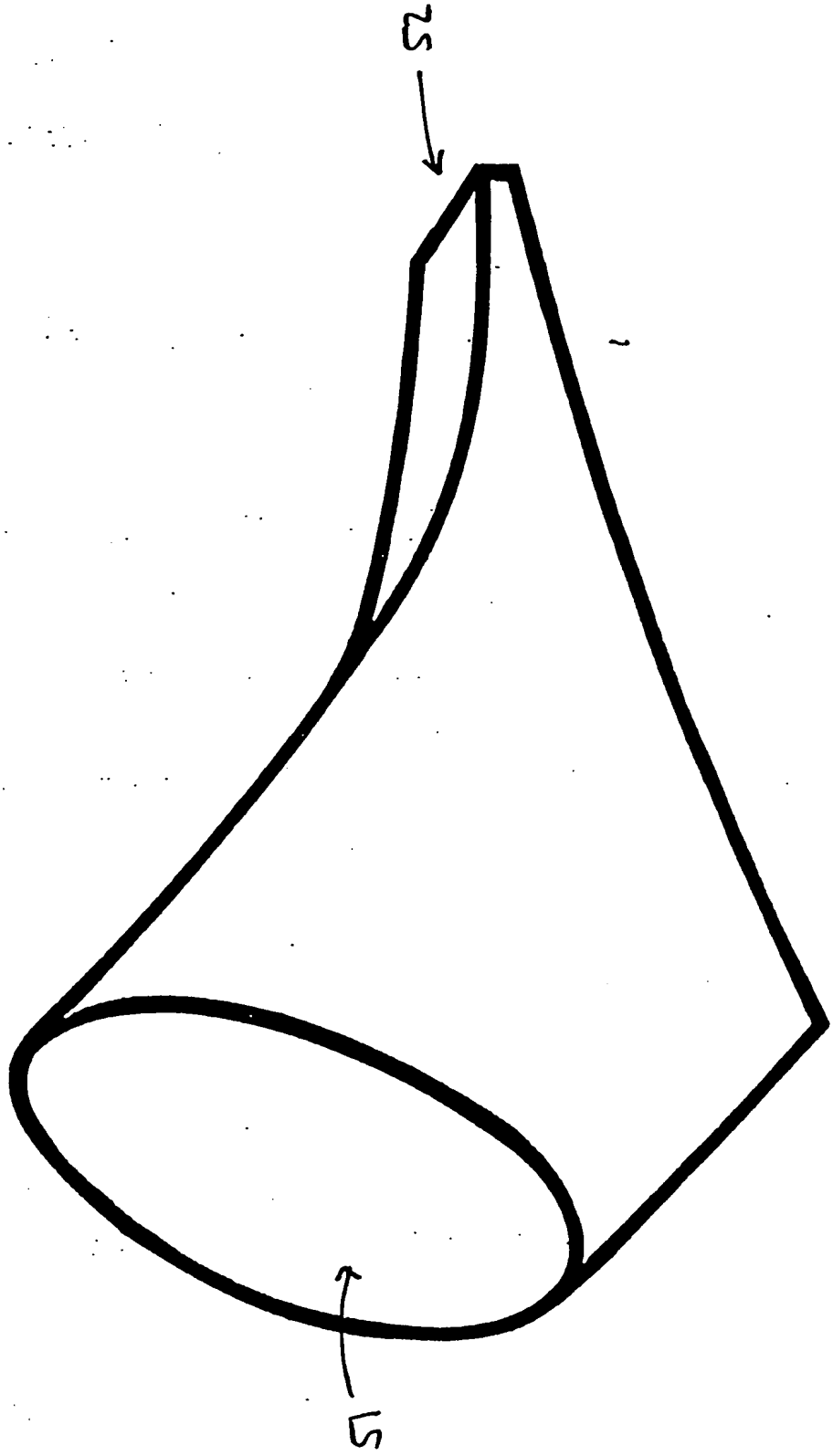



Fig. 5b

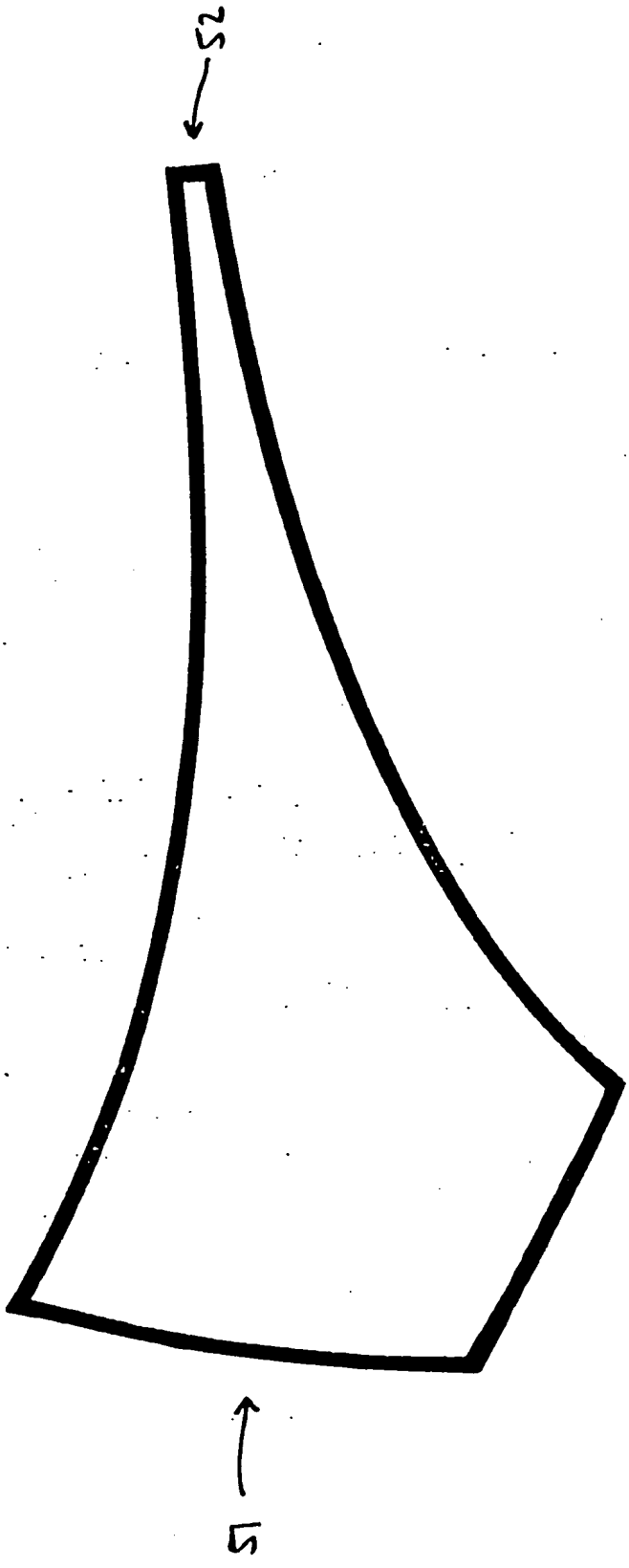



Fig.5c

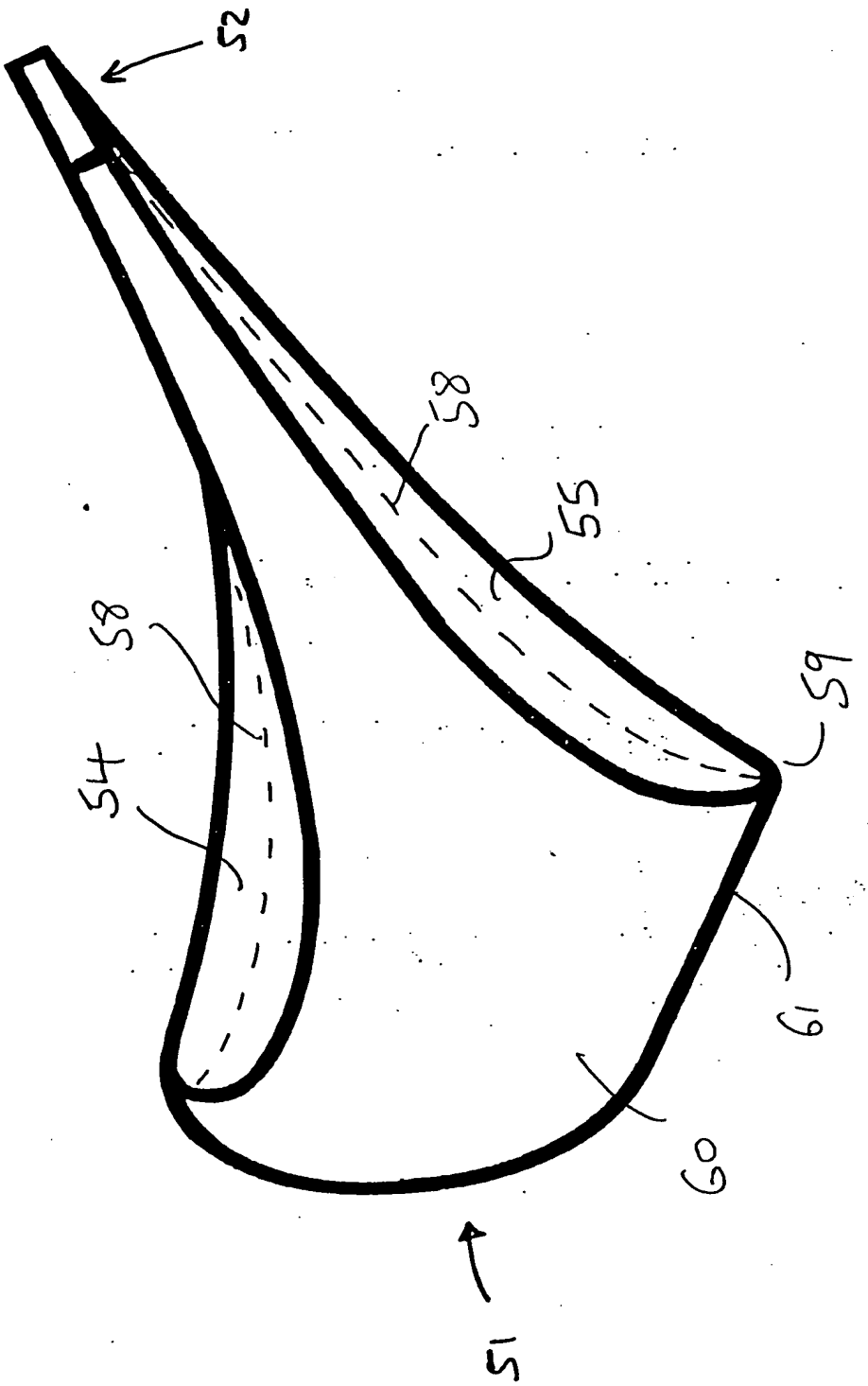



Fig. 5d

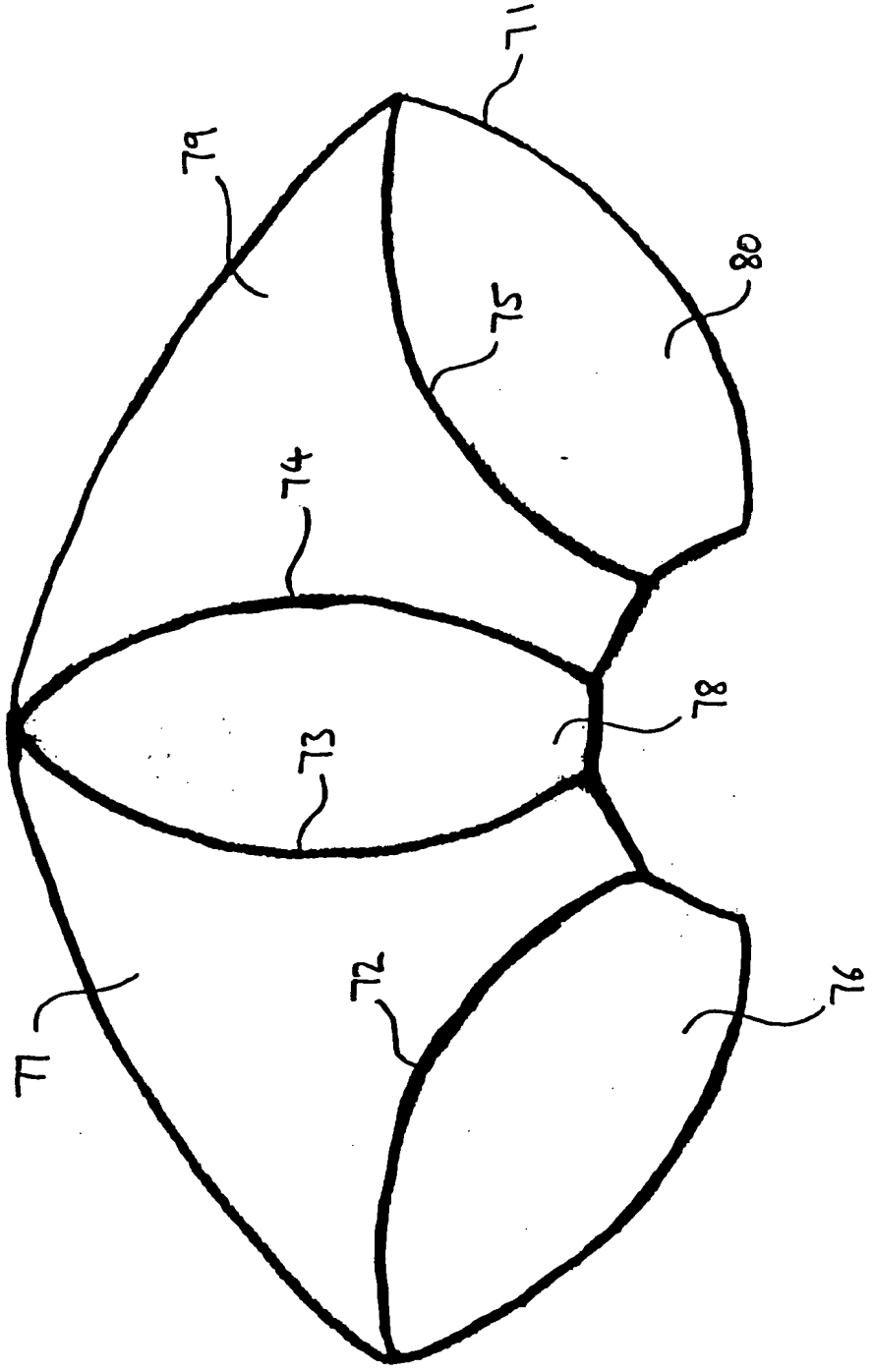



Fig. 7

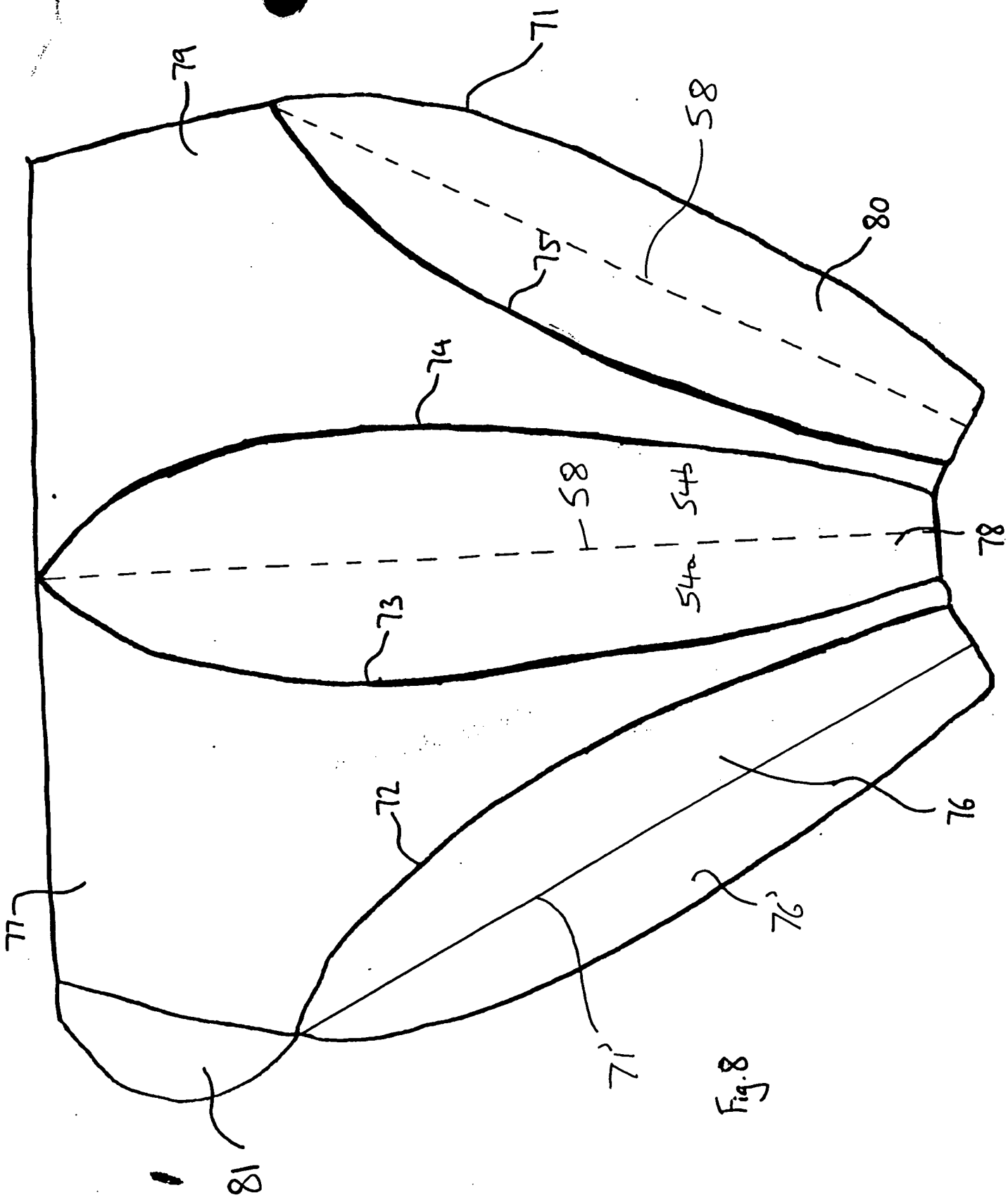



Fig. 8

Fig 9a

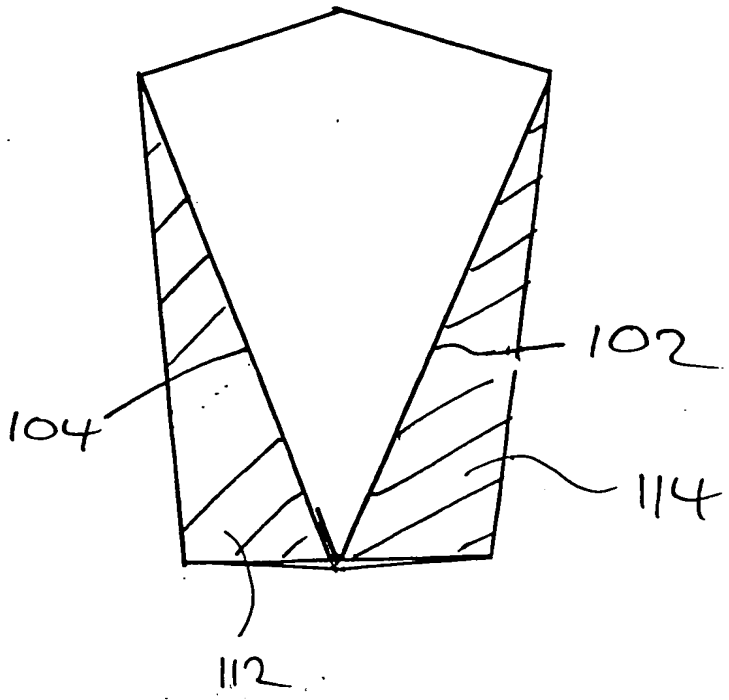
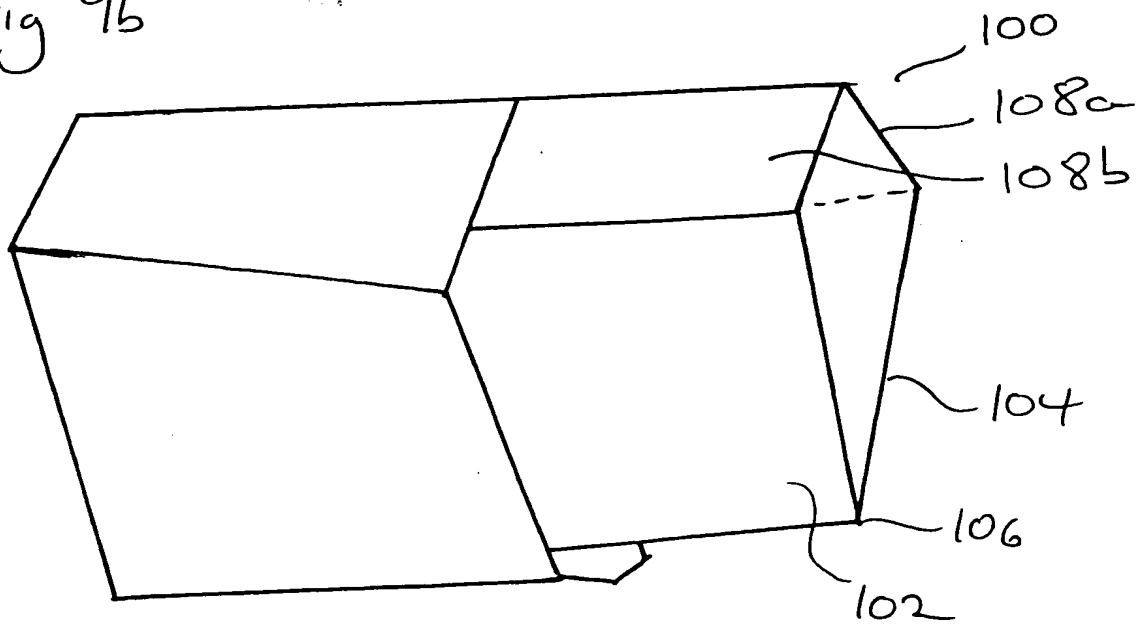



Fig 9b



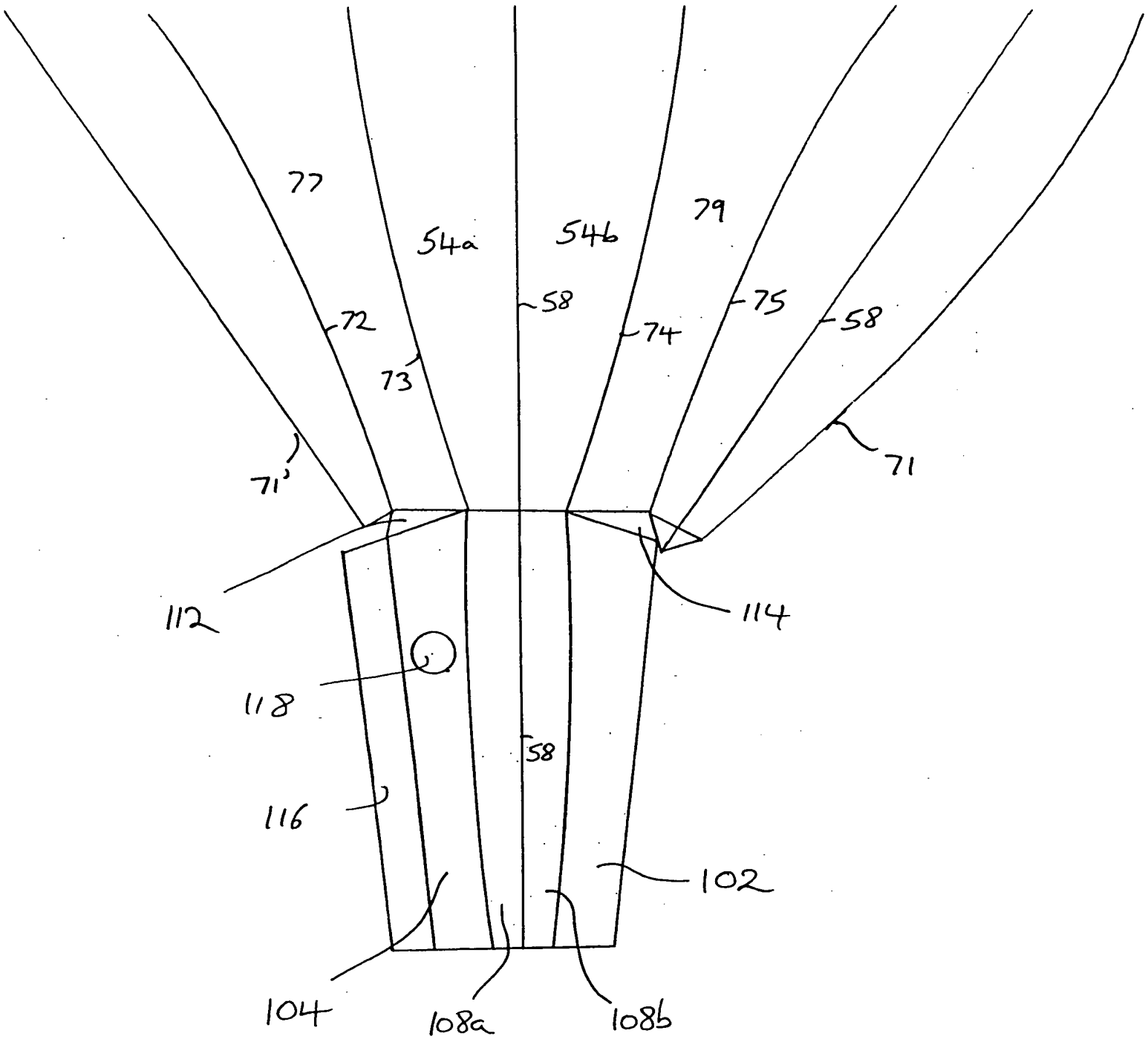

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Fig 10

Fig 11

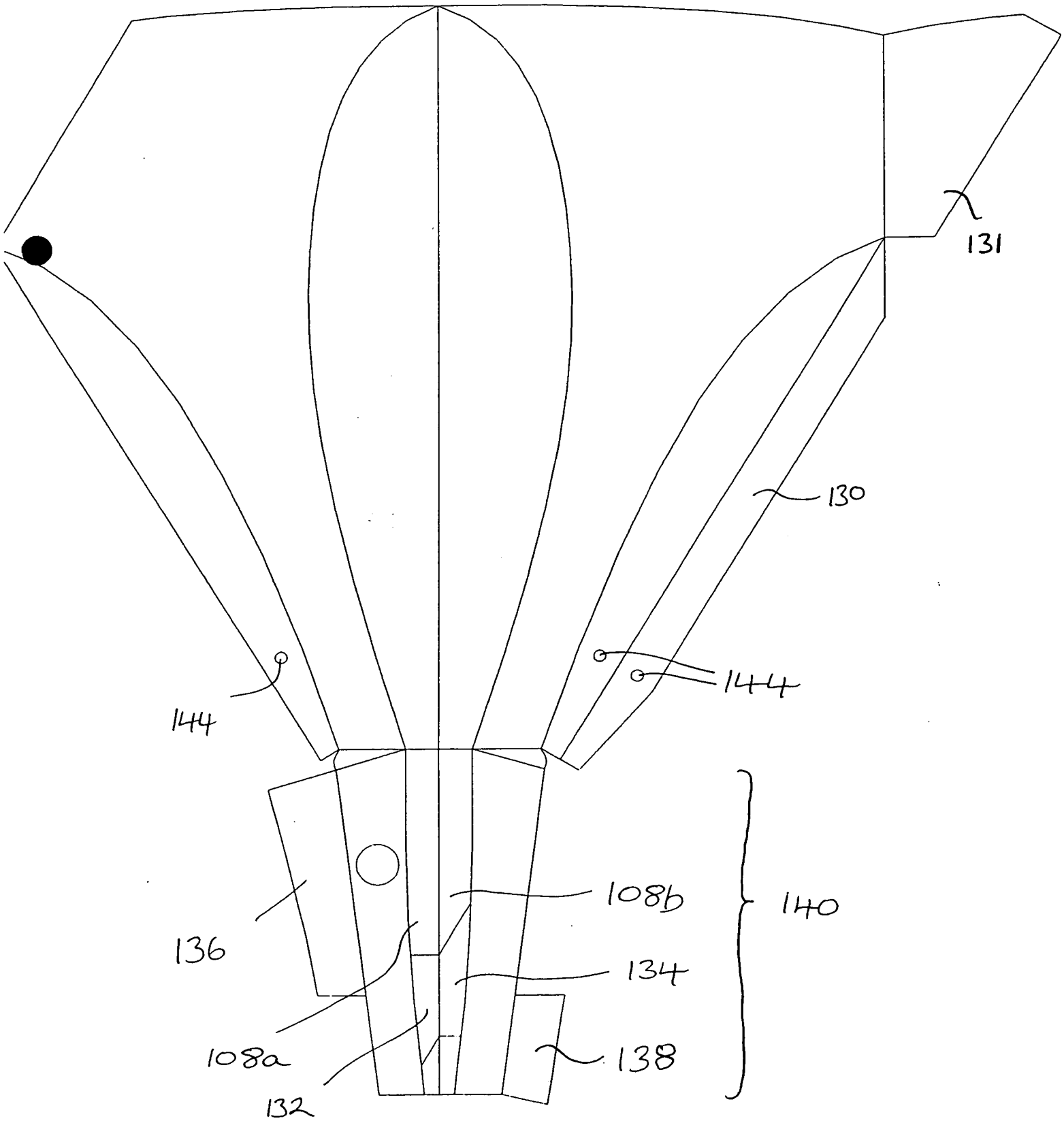
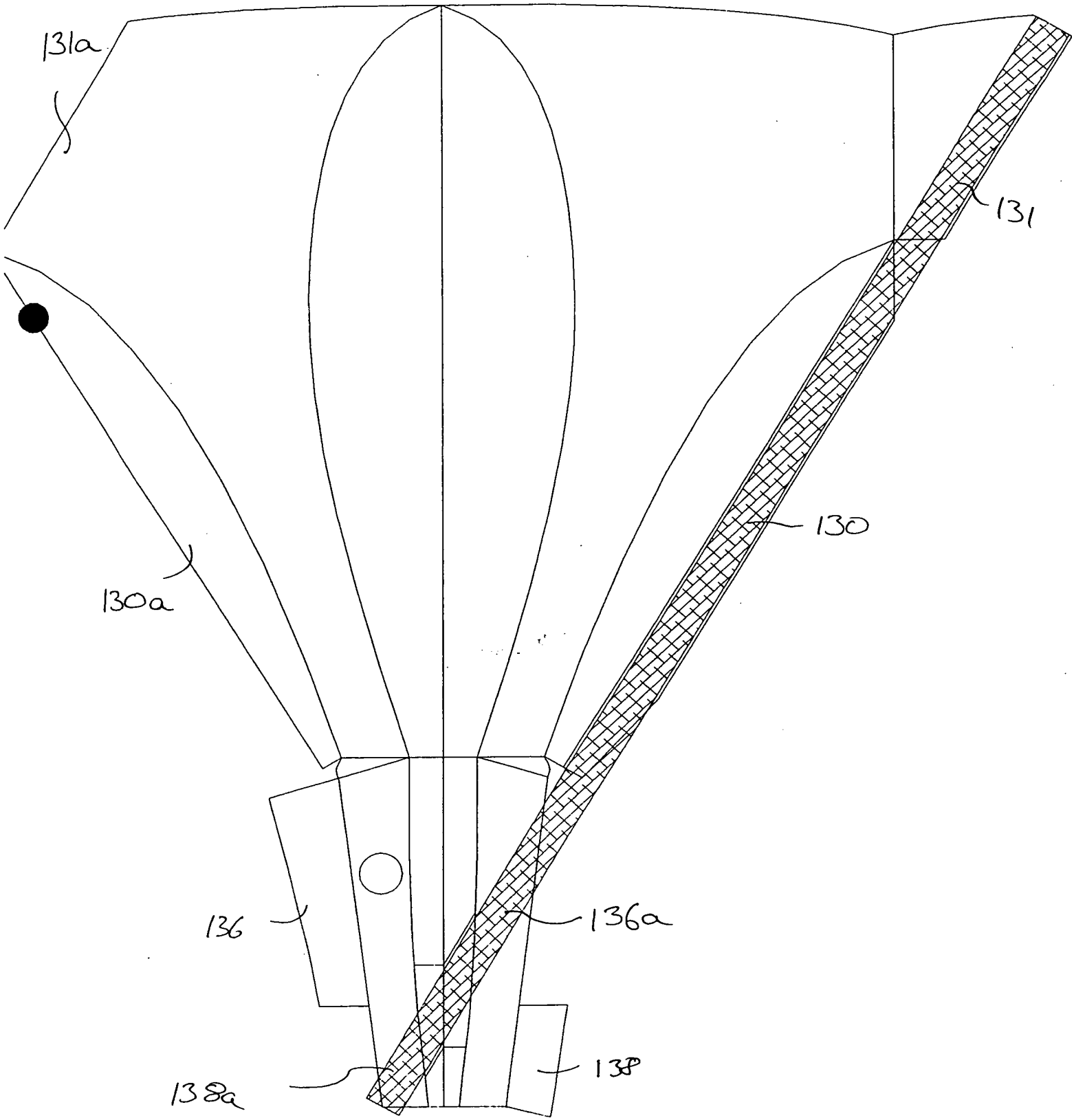


Fig 12



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Agent : Langner Parry